Anatomy of cartel contracts

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Abstract

We study cartel contracts using data on 18 contract clauses of 109 legal Finnish manufacturing cartels whose legal status is reminiscent of e.g. the U.S Sugar Institute. One third of the clauses relate to raising profits; the others deal with instability through incentive compatibility, cartel organization, or external threats. Cartels use three main approaches to raise profits: Price, market allocation, and specialization. These appear to be substitutes. Choosing one has implications on how cartels deal with instability. Simplifying, we find that cartels economize on contract clauses, cartels in homogenous goods industries allocate markets, and small cartels avoid competition through specialization.

JEL: L40, L41, K12

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1   Introduction

For competition policy to be effective, we need to understand how cartels work. To this end, it is of first order importance to analyze what issues cartels aim to solve and how. Our understanding of cartel organization and operation remains inadequate even though it has improved through both in-depth analyses of individual cartels (Genesove and Mullin 2001, Asker 2010), game-theoretic modeling of cartel contracts observed in some of the recent exposed cartels (Harrington and Skrypacz 2007, 2011) and qualitative analyses of cartel practices (Harrington 2006, Marshall and Marx 2012). A key factor inhibiting further progress has been lack of data that would allow a quantitative analysis of cartel contracts: that is, how do the contracts look like? Are contracts very similar, or not? What contracting features are used most often? Do some features of contracts appear together often? To address these questions calls for detailed data on the contracts of a large number of cartels, operating preferably in a shared institutional environment. Through archive work, we have generated a data set that enables us to offer such an analysis and to provide an anatomy of cartel contracts, i.e., a list of their stylized facts.

The anatomy of cartel contracts is important in two ways: First, by providing information on how cartels operate, it helps competition authorities decide where to allocate resources for the detection of cartels and courts and legal scholars to determine the nature of cartel agreements (e.g., Kaplow 2011a,b and Harrington 2012). Second, it provides a basis for further development of cartel theory along the lines initiated by Harrington and Skrypacz (2007, 2011) towards models that are in line with stylized facts. Such models are instrumental in pushing further our understanding of how cartels operate, and what types of policies are likely to be effective against them.

Cartels have to solve two fundamental issues: How to raise and allocate profits? and, How to deal with the inherent instability of the cartel agreement? To better under-

stand how these problems are solved and how the cartel contracts look like, we follow a four-step research approach.

In the first step, we collect and quantify data on cartel contracts. We define a *contract clause* to be a binary choice, indicating whether or not a particular contracting feature is covered. A *cartel contract* can be described by a vector of such clauses and the set of possible cartel contracts define the available *contract types*. Using this terminology, the received cartel literature (e.g., Stigler 1964, Harrington 2006, Marshall and Marx 2012, chs. 6 and 7) allows us to identify 18 contract clauses. These clauses can be classified into four *economic dimensions*: The first economic dimension relates to how the cartel aims to raise profits. One third of the identified contract clauses serve this purpose. The remaining two-thirds of the clauses relate to the instability of cartels and can be grouped into three economic dimensions: How does a cartel seek to solve the incentive compatibility constraint on which economic research has very much concentrated?; How does a cartel organize itself and settle internal disputes?; and, How does a cartel deal with external threats? We expect cartels to only use those contract clauses which address problems they can anticipate to emerge and whose benefits exceed the costs of including them into the contract (see also Kaplow 2011a, pp. 758-765).

In the second step, we analyze the four economic dimensions, the individual clauses of the cartel contracts as well as their correlation structure to pin down the broad *contracting approaches* cartels use. This entails looking for contract clauses that consistently appear together both within and across the four economic dimensions.

In the third step, we scrutinize how the cartel contracts relate to the size of the cartel in terms of the number of members and to whether the industry produces homogenous or differentiated products. Our motivation to consider the number of cartel members is the attention it has received in the prior literature. In particular, the supergame-models of collusion suggest that the incentive compatibility constraint is a function of

the number of firms in the cartel (industry), with more firms leading to the incentive compatibility condition being harder to satisfy. We focus on product differentiation because almost nothing is known empirically about how this industry feature is associated with the organization and workings of cartels, despite the attention Stigler (1964) devoted to it in his seminal paper.[1]

In the fourth step, we provide an exploratory analysis of the complexity and stability of cartel contracts. As far as we are aware, the prior literature is largely silent about them, but they are potentially important in informing policy (e.g., can relatively simple and short contracts sustain collusion?) as well as in furthering the economic theory of cartel contracts (e.g., how often are contracts updated?). A notable study is Taylor (2007), who finds little relation between industry characteristics and use of individual clauses, or length of the contract.

To implement this four-step research approach, we have collected detailed information on the contracts of 109 Finnish manufacturing cartels. Like the U.S. Sugar Institute analyzed by Genesove and Mullin (2001), these cartels were legal, although the enforceability of the contracts was unclear (see section 3). The cartels covered the whole national market and were registered between 1959 and 1988 by a predecessor of the Finnish Competition Authority. We use information from this Registry to establish which contracting clauses the cartels adopted. The strengths of these data are twofold: first, the cartels operated in the same institutional environment, removing one potentially large source of heterogeneity (in contracts). Second, unlike illegal cartels, legal cartels do not have to worry about the consequences of explicitly writing down their

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[1] The available empirical studies (see, e.g., Levenstein and Suslow, 2006, for a review) suggest that collusion mostly occurs in homogenous goods industries, but the small theoretical literature on the effects of product differentiation on collusion is divided on the issue.

agreements. We can thus "observe an unobservable", i.e. what illegal cartels would like to write down, if doing so would not have adverse legal consequences.[2]

While several papers (e.g. those surveyed in Levenstein and Suslow 2006 and Taylor 2007 in particular) report descriptive statistics on what cartels agree on, none, to the best of our knowledge, takes the analysis of cartel contracts further. Our contribution is to provide an anatomy of the cartel contracts by describing the systematic patterns by which collusion is pursued.

The first step of our research approach shows – consistent with the case studies of Harrington (2006), the literature review of Levenstein and Suslow (2006) and the case studies and theoretical modeling of Harrington and Skrzypacz (2011) – that cartels coordinate on pricing and allocate markets. They also frequently use some type of a non-competition/specialization clause, which often entails coordination on the positioning in the product space (i.e., who specializes on what). This appears to be more common than (pure) market allocation schemes. We also find that many, *but not all*, cartels contract on the incentive compatibility constraint, some aspect of their internal organization as well as on how to deal with external threats.

The second step of our research approach shows that while essentially all cartels agree on some mechanism to raise joint profits, they differ in how they approach this. By and large, we find three basic contracting approaches: The choice to agree on prices, to use some type of non-competition/specialization clause or to allocate markets has implications to the rest of the contract. For example, cartels that use allocation of markets to raise profits make heavier use of contractual clauses designed to affect the incentive compatibility constraint, such as mechanisms of monitoring, enforcement and fines.

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[2] The cartels that we study were legal. We discuss the implications of this for our analysis and interpretation in Section 8.

If cartels use some type of non-competition/specialization clause they are less likely to have clauses for incentive compatibility and for organizational purposes.

The third step of our analysis shows that the size of the cartel is significantly associated with how the cartel seeks to raise profits. For example, the number of cartel members is negatively correlated with the use of the non-competition/specialization clause. Cartel size is also positively associated with the use of instability clauses. In contrast to the results on cartel size, we find that cartels in homogenous goods industries are more likely to use market allocation to raise profits. Furthermore, several of the correlations between how a cartel raises profits and how it deals with instability are explained by the number of members and homogeneity of products.

Finally, in the fourth step, we find some evidence that larger cartels use more complex contracts (measured by the number of pages and the number of clauses), as do cartels in industries with product differentiation. While market allocation cartels seem to have more complex contracts, pricing cartels change them more often.

The rest of the paper is organized as follows: First, we relate our analysis to the previous economic literature on cartels and contracts in section 2. The institutional environment in which our cartels operated and our data sources are described in section 3. We then proceed in section 4 to describe in detail the 18 contracting clauses on which we have collected information. We explore how cartels seek to raise profits and how they address the instability of the cartel arrangement in section 5. We extend this analysis in section 6, where we look at how the size of the cartel and whether the industry produces homogenous or differentiated goods, correlate with the types of cartel contracts used. In section 7, we analyze the complexity and stability of cartel contracts. Section 8 discusses the extent to which our empirical findings generalize. Section 9 concludes by discussing the policy implications of our results and suggests directions for future theoretical work.

2 Related literature

First of all, our analysis is related to the empirical research that explores the internal workings and organization of cartels. Second, a number of theoretical papers in economics have explored the sustainability of collusive outcomes and the strategies and environments that support them. As Kaplow (2011a,b) and Harrington (2012) stress, this economic approach is distinct from the legal approach to collusion, which emphasizes the nature of mutual understanding and agreements by which collusive behavior is pursued.

2.1 Internal workings and organization of cartels

An interesting nascent empirical literature studies the internal workings of a cartel.[3] Genesove and Mullin (2001) study the U.S. sugar cartel by analyzing the documents from the meetings of the cartel. They show that the cartel resorted to negotiations in the face of contract violations rather than (directly) going for a punishment (e.g. price war). The cartel also came up with contractual remedies to the problems that surfaced. Asker (2010) studies the operations of a New York-based stamp collector's cartel and finds that despite their very refined operations, the damage they caused was limited. Insightful studies on individual cartels, like the ones mentioned, show that there is heterogeneity in both cartel design and performance that depend on the environment. We seek to bridge the gap between a deeper understanding of the detailed workings of an individual cartel and the need to observe stylized facts that pertain to a larger sample of cartels, both of which are crucial e.g. in designing the right policies.

Another strand of the cartel literature studies samples of cartels. Suslow (2005) studies the relation between formal cartel contracts and the structure and durability of cartels using a sample of legal cartels, finding that uncertainty in the operating environ-

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[3] A much larger literature studies the behavior of individual cartels. Prominent examples are Pesendorfer (2000), Porter and Zona (1993, 1999) and Röller and Steen (2006).

ment is inversely related to the stability of cartels. Taylor (2007) analyses the cartel codes from the National Industrial Recovery Act for cartels registering between 1933 and 1935 in the US and finds that high complexity of cartel codes (contracts) was correlated with slower output growth, indicating that cartels were successful in restraining output. He also tabulates contract characteristics, but has fewer of those than we, and does not proceed to a systematic analysis of how the contracts look like. Levenstein and Suslow (2011) are close to us in having collected information on comparable contract characteristics of cartels; in their case, of illegal international cartels. Like Taylor (2007), they consider them as determinants of an outcome, in their case of cartel duration. We build on these recent papers and their predecessors (see, e.g., Fraas and Greer 1977, Hay and Kelley 1974 and Posner 1970) by bringing new data on legal cartels that share a common institutional environment, to bear on a less-studied aspect of cartels, the anatomy of cartel contracts. We extend the existing work by offering a framework for analyzing and describing cartel contracts from an economic point of view, and by analyzing these contracts in detail. The earlier papers have not focused on the broader attributes of how collusion is organized, nor characterized the relative importance of various incentive compatibility conditions and other contractual features across the different forms of collusive schemes.

The received theoretical literature suggests that cartel formation and stability should typically be inversely related to the number of market participants and cartel members, but empirically that seems not to always be the case (Levenstein and Suslow, 2006). Even less is known about how product differentiation is associated with the organization and workings of cartels. The empirical literature does suggest that collusion mostly occurs in homogenous goods industries (see e.g., Levenstein and Suslow, 2006), but the theoretical literature addressing the same question portray a more mixed picture. Chang (1991) and Ross (1992) find that differentiation makes collusion easier, while

Raith (1996) and Häckner (1994) find the opposite.[4] Thomadsen and Rhee (2007) show that costs of maintaining collusion increase the difficulty of sustaining collusion more for firms in industries with product differentiation.

2.2 Collusive outcomes and cartel agreements

Building on the seminal work of Stigler (1964), the economic theory of collusion focuses on outcomes, such as the level of sustainable collusive prices and quantities, and the importance of monitoring, communication and punishment for cartel stability in various environments. For example, economic theories of legalized cartels, as Athey and Bagwell (2001) call them, assume that the colluding firms can make transfer payments and that such payments can be supported by enforceable contracts. Examples of these papers include Roberts (1985), Cramton and Palfrey (1990) and Kihlström and Vives (1992). These models show that when there is private information about production costs, a mechanism of communication is needed for the efficient allocation of production among the colluding members and that transfer payments can be used to ensure truthful communication. Athey and Bagwell (2001) show that when pricing decisions are public (but costs not) and when competition policy prevents the use of transfer payments, firms may resort to market-share favors to ensure truthful communication of costs (see also Athey and Bagwell 2008). Building on Athey and Bagwell (2001), Hörner and Jamison (2007) show that collusion can also emerge without communication. This model predicts that in a limited-information environment, colluding firms aim at agreeing both on prices and markets shares and that a violation of the collusive agreement in either dimension triggers a punishment. Aoyagi (2002), Hanazono and Yang (2007) and Gerlach (2009) provided related analyses, but focus on the exchange of information about demand.

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[4] Deneckere (1983), Majerus (1988), Rotschild (1992), Ross (1992), Häckner (1994), Raith (1996), Lambertini and Schultz (2003) and Schultz (2005) study closely related models and questions.

More recently, Harrington and Skrypacz (2011; see also their 2007 paper) have analyzed the properties of an equilibrium that qualitatively match the key dimensions of observed cartel agreements in certain markets, and show under what conditions such an equilibrium exists. In their model, there is private information about prices and sales (but costs are publicly observable), and the colluding firms can exchange information about sales. The analyses of Harrington and Skrypacz suggest that a solution to the problem of secret price cuts is – besides price wars (Green and Porter 1984) – that firms use transfer payments that are conditioned on the reported sales.

We note four things about the economic theory of collusion: First, the received literature stresses the importance of communication, monitoring, side-payments and punishments. The effectiveness of these mechanisms depends on the assumed information structure and market environment. The broader organization of cartels is however not studied and predictions about the *types* of collusive schemes (e.g., price fixing, market allocation) or about the potential complexity of the collusive agreements are rarely made, even though these issues were emphasized already in Stigler (1964).

Second, in the available economic literature, explicit collusion calls for a degree of overt communication about promises, information and/or the associated arrangement. The boundary between tacit and explicit collusion is nevertheless not always clear-cut. In contrast, the legal literature on collusion is about the nature of this boundary, i.e., whether and when inter-firm communication is explicit enough to lead to unlawful co-ordination (see Kaplow 2011a,b and Harrington 2012). Like ours, the interest of the legal scholars (and courts) has for long been in understanding the overt agreements by which collusive behavior is achieved.

The third thing to note is that the extent to which the different economic models are about illegal or legal coordination is a matter of degree. On the one hand, in some models, there is neither a competition authority nor a risk of detection, but competition

policy is assumed to restrict the interaction of firms in some way. These models implicitly assume that the forbidden actions are never taken. On the other hand, there are models that explicitly allow for a risk of detection and the legal consequences of taking an unlawful concerted action (e.g. Harrington 2004).[5]

Finally, the prior economic literature has not explicitly considered the verifiability of cartel arrangements in court. The theory of incomplete contracts relies on the notion that all possible contingencies cannot be anticipated and that not all arrangements can be verified by an outsider (such as a court). The theory predicts that if cartel contracts fall into the category of incomplete contracts, cartels should mostly agree on control rights, discretion and decision-making rules (Bolton and Dewatripont 2004, pp. 37). Moreover, the theory of endogenously incomplete contracts suggests that like legal cartels, illegal cartels are likely to make use of (only) those contract dimensions whose benefits exceed the costs of including them into the (actual or virtual) contract.[6] Indeed, the very fact that cartels are illegal leads to endogenous incompleteness of cartel contracts, because the contracting parties have a strong incentive both to reduce the ability of a court to verify the contracted actions and to make unverifiable what is observable. Bar for this difference, legal and illegal cartels have similar incentives to economize on

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[5] However, even if the legal consequences of collusion were not explicitly considered, a model may by applicable to unlawful collusion. This would be the case if the nature of the collusive outcome and its properties do not change (much) when the risk of detection is explicitly introduced.

[6] The benefits are related to the increased collusive profits and greater stability, whereas the costs can be cognitive (Tirole 2009), informational (Spier 1992) or plain ink costs (e.g. Dye 1985, Anderlini and Felli 1994, Battigalli and Maggi 2002, 2008), or some combination of the three. The theory that treats the completeness of contracts as endogenous has not yet settled on key determinants; see, e.g., Bolton and Dewatripont (2004) for a textbook treatment and Tirole (2009) and Kvaløy and Olsen (2009) for some more recent advances.

contract completeness in their attempt to coordinate on actions and meet the incentive compatibility constraint. [7]

3   The institutional environment and data

This section describes both the institutional environment in which our cartels operated and our sources of data.

3.1   The institutional environment

The development of Finnish competition policy after the Second World War follows closely developments in other European countries, and Sweden in particular. There was no competition policy before the war (see Fellman 2008, 2010). After the war, a committee was set up in 1948 to draft a framework for competition legislation. This work resulted in the first cartel law which took effect in 1958. The central idea was to collect information on cartels that operate in the domestic market (export cartels were outside the scope of the Registry) rather than deter collusive activities. For this purpose, a (predecessor of the) Finnish competition authority (CA) was set up and given the task to register cartels. The first cartel law did not precisely define what a competition restriction (or a cartel for that matter) means (Fellmann 2010), but the scope appears to have been broad. The law however explicitly outlawed only bidding rings.

The CA began registrations in March 1959. The Registry was active, sending out thousands of inquiries and registering several hundred cartels already during the first

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[7] Our research also has connections to the empirical work on contracts. Lerner and Merges (1998) study the allocation of control rights in alliances between US bio-technology companies and firms sponsoring them financially. Chiappori and Salanie (2000) use French insurance data to test for the existence of asymmetric information in contractual relationships. Ackerberg and Botticini (2002) explore the econometric consequences of endogenous matching in the context of a contracting relationship using historical Italian data on contracts between landlords and tenants. In a paper that is close in spirit to ours, Kaplan and Strömberg (2003) use venture capital contracts in the US to investigate how well their dimensions map to the predictions of financial contracting theory. A difference between our paper and theirs is that while they could confront their empirical regularities with a rich theoretical literature on financial contracting, the existing theoretical literature on the organization of cartels and cartel contracts is rather thin. This lack of theoretical research implies that we cannot "run a horse-race" between different theories.

three years of its operation. Registration was contingent on the CA contacting the suspected cartel members, but the law stipulated that firms had an obligation to respond and inform the Registry if a competition restriction existed. This changed in 1964 when the law was revised. Now cartels with a formal organization (such as an association) had to register on their own and failing to register could result in a small fine. In 1973 the registration requirements were again somewhat tightened. In the 1980s Finland finally edged towards a modern competition law, as the work of a committee established in 1985 resulted in a new law taking effect in 1988. This cumulative process of law changes that progressively made the environment less permissive now made void possible sanctions in cartel agreements. A primary motivation for this change was the only known law suit based on a cartel contract from early 1980s that had led to damages being awarded.[8] This incident suggests that there was - similar to the case of the U.S. Sugar Institute (Genesove and Mullin 2001, pp. 385) – a great deal of ex ante uncertainty as to the enforceability of these contracts in court: taking your fellow cartel member to court seems to have carried the risk of affecting the legal environment. Cartels became illegal in the beginning of 1993.

Our understanding of the past regime, based on written accounts and discussions with people familiar with the era, is that the costs of registering were minor. It also seems that there were some benefits tied with registering. The former and current Director Generals of the Finnish CA (Purasjoki and Jokinen, 2001) sum up the environment concerning those collusive practices that were legal: "*Time was such that there seemed no need to intervene even in clear-cut cases, especially if they had been registered. Reg-*

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[8] We have interviewed people with a long working history in the Finnish Competition Authority. They could recall only one case from the early 1980s. According to the Director General of the Finnish Competition Authority, Juhani Jokinen (private exchange), this case lead to the law change in 1988 making sanctions in cartel contracts void. Note however that several of the cartel agreements stated that conflicts were to be solved by the parties meeting for the Finnish Chamber of Commerce. Since these arbitrations are not known to the public in retrospect we do not know to which extent this option was used (see also footnote 16).

istration had been transformed into a sign of acceptability of the [cartel] agreement, at least for the parties involved [in the cartel]".

3.2   Data sources

Our data consist of information on cartel contracts, industrial statistics and macroeconomic variables. They come from three sources.

All the data on cartel contracts is based on archive work in the Registry. For each registered cartel, the Registry established a folder, and gave an identification number. The folder contains all the correspondence between the Registry and the cartel. The Registry also always asked for the actual cartel contract. Once a cartel was registered, basic information on it was published in the Official Journal of the Finnish government. Thus, the Registry made cartels public. All our data on the contracts and cartels are based on the information available in the Registry.

The Registry contains in total some 900 cartels. As archive work is time consuming and expensive, we could not include all of them in our sample. We decided to concentrate on nationwide manufacturing cartels, and chose to include the first cartel(s) in a given (3-digit) industry. This resulted in us going through the folders of 109 cartels in a very detailed manner.[9]

We used a semi-structured approach to collect information on 18 contract clauses.[10] We discuss the clauses and other information we collected shortly. In addition to this information on contract clauses we collected information on the length (in pages) of

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[9] In terms of the form of the contracts, there did not seem to be a clear pattern. Thus unlike in Austria (private correspondence with Konrad Stahl and Christine Zulehner), registrations were not done through law firms, nor was a standard template (e.g. by the Chamber of Commerce) used.

[10] After initial discussions on how to interpret contracts, we first randomly chose eight cartels and had four researchers go through each of them independently. We then checked for any differences in interpretation, and decided on a common approach. We thereafter followed a written protocol with the 109 cartel contracts.

the contract, the number of contract changes and the number of members in the cartel. We collected information on the contract that was in force at the time of registration.[11]

To this data we have matched 4-digit industry statistics from Statistics Finland, measured in the year prior to the registration of a cartel. To measure product differentiation we have constructed an index (*Homogenous_d*) that indicates whether an industry primarily produces homogenous goods (= 1) or not (= 0). We followed the existing literature (Rauch 1999, Foster, Haltiwanger, Syverson 2008) and studied the characterization of each 4-digit industry, and the Registry's description of the goods produced by the cartel to determine whether the cartel was producing homogenous goods or not.[12] Finally, our source for macroeconomic variables is the database of the Research Institute of the Finnish Economy (ETLA). We describe the industry- and macrovariables in greater detail in section 6.

Our four-step research approach is summarized in Figure 1. Quantification of cartel contracts (step 1) is described in the next section. We identify contracting approaches (step 2) in section 5. We analyze contract heterogeneity (step 3) as well as complexity and stability (step 4) in section 6 and 7, respectively.

[FIGURE 1 HERE]

4   Cartel contracts and contract clauses

4.1   Quantifying cartel contracts

A *cartel contract* can be described by a vector of contract clauses. Each clause is binary, describing whether a particular contractual feature is or is not included in the contract.

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[11] To be more precise, we also know how many times the registered contract was changed subsequently. However, we do not have data on the precise reasons for those changes. We therefore do not study how an individual contract changed over time (in contrast to e.g. Genesove and Mullin's 2001 analysis).

[12] To give a couple of examples, the cartel producing cardboard was classified as a homogenous goods cartel, while the cartel producing dairy products was classified as producing differentiated goods. We sought to be conservative in classifying an industry (cartel) to produce homogenous goods. An inspection of the industries and the classification suggests that many of the industries we classified as producing homogenous goods are upstream industries selling to other firms rather than directly to consumers.

We collected information on 18 potential contract clauses, basing our work on Harrington (2006) and more broadly on the economics of cartels (e.g., Stigler 1964, Levenstein and Suslow 2006, Marshall and Marx 2012, chs. 6 and 7). Excluding the possibility of not choosing any clause (as this would result in there not being a contract), each cartel in our data uses one of the $2^{18} - 1$ (= 262 143) possible types of cartel contracts (i.e., *contract types*).

The different clauses can be classified in four *economic dimensions*: The first refers to how the cartel affects the market outcome – raises profits. One third (6) of the contract clauses fall in this dimension. The remaining two thirds relate to cartel instability. To systematically analyze these latter 12 clauses we group them further into to three economic dimensions. This leaves us with four dimensions: i) market power attributes (MPA), which describe what a cartel agrees upon to increases its profits, and three instability dimensions; ii) the incentive compatibility constraint (ICC), which is about the different contractual ways of dealing with incentive compatibility; iii) the internal cartel organization (ICO) of the cartel, and iv) the external cartel contract (ECC), which is about dealing with external threats.

The upper part (Panel A) of Table 1 provides an overview on the 18 contract clauses, the economic dimensions to which they match and more specifically how they are coded. We now summarize our contract data (N = 109) in detail.

[TABLE 1 HERE]

MPA – Market Power Attributes

Six of the 18 contract clauses have to do with MPA. This category includes the following measures: *Pricing*, *Market allocation*, *Efficiency*, *Technology*, *Non-price clauses* and *Non-competition/specialization*. Of the 63 contracts that use *Pricing*, 78% agree on

price, 10% specify a pricing rule, 49% rules on discounts, and 48% terms of delivery.[13] Sales quotas are used by 66% of the 29 cartels using *Market allocation*, territories by 28% and a home-market principle by 10% (i.e., in the latter case refrain from entering each other's (geographic) "home" markets).[14] As an example of an *Efficiency* clause, some contracts stipulate that the member whose facility is closest to a given customer should deliver the goods. Sharing of technological knowledge, such as patents or blue-prints, is covered by *Technology*. Non-price restrictions are attributed to *Non-price clauses,* including things like add-ons, bundling, and quality.[15] Our last MPA-clause, *Non-competition/specialization* was used by 39% (42/109) of the cartels. These clauses may take many forms, but often refer to a division of labor between the firms and (ge-neric) statements not to compete.

The difference between a cartel having the *Non-competition* clause and having the *Market allocation* clause is that the former includes the parties agreeing e.g. on parti-tioning the production of goods with one of the parties or agreeing to cease production of certain parts of the good in question, whereas the latter has no explicit reference to production, only to distribution. The cartels using *Non-competition/specialization* are not the standard textbook cartel because, after implementation, often only one of the parties remains active. We feel that it is justified to regard these as cartels first, because the transaction ensures that joint profits can be maximized and second, as the contracts

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[13] These clauses turn out to be mostly substitutes: All other correlations but that between discount rules and terms of delivery (0.33, p-value 0.01) are negative. Only two however are statistically significant. Price and pricing rule have a correlation of -0.61 (p-value 0.00) and discounts and pricing rule a correla-tion of -0.21 (0.10).

[14] With only 29 cartels using *Market allocation*, an analysis of correlations is at best suggestive: Keeping that in mind we find that all correlations are negative and large in absolute value: -0.21 (the home-market principle and territories), -0.47 (sales quotas and the home market principle) and -0.69 (sales quotas and territories), and all but that of the home-market principle and territories statistically significant.

[15] We also collected qualitative evidence information on the *Non-price* clause. We didn't find much, and the most frequent were different ways of minimizing product differentiation. For example, cartels could agree on standardizing products, or packages.

very often include non-competition clauses where the party ceasing production is not allowed to re-enter, nor to sell its knowledge to third parties.

ICC – Incentive Compatibility Constraint

We looked for four ways of dealing with ICC. *Monitoring* indicates whether the members monitor each other. As an example, the plywood cartel had a clause whereby "all information on sales, deliveries and production must be given to the Association twice a month; twice a year a certified auditor's statement of the correctness of previous notifications is required". *Enforcement* refers to those contracts that stipulate how to handle situations where a member has deviated. Such instances include the mention of price wars of some type, retaliation, and compensations. An example is the clause used by the glass cartel: "The delegation has the right to order production reductions or temporary closing of a plant. Compensation must then be paid". If the cartel has rules on how to expel a member if rules are broken, this is captured by *Expel*. Similarly, for contracts including clauses on monetary fines for a company that violates the contract, *Fine* takes the value one. Fines were usually either a percentage of some measurable activity like sales; sometimes a minimum monetary fine was defined.

ICO – Internal Cartel Organization

The third economic dimension, ICO, is captured by five measures. *Meeting* identifies the contracts that stipulate whether, and if so, how often, the members are to meet. *Dispute-resolution* in turn denotes whether the contract specifies a way in which disputes among members are to be resolved. There were two primary ways in which disputes resolution was specified in the contracts: either an internal mechanism, or an external mechanism (court, arbitration).[16] *Structure* indicates whether the cartel has a formal structure, such as an association or a limited liability company to organize itself. *Vote* is

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[16] One solution used by cartels was to use the arbitration provided by the Finnish Chamber of Commerce, used e.g. by the match makers cartel after their reorganization. The Chamber unfortunately keeps the (as such confidential) arbitration documents for only ten years, and thus their archive would not shed light on whether cartel members really resorted to arbitration.

an indicator for contracts that include a clause for a voting procedure.[17] Finally, *Sales* measures if the cartel has formed either a trade or a sales association.

ECC – External Cartel Contract

We searched for three ECC characteristics: *New members* indicates whether the contract specifies a policy on how to accept new members. *Non-cartel supply* quantifies whether or not the cartel members have a clause on how to deal with supply from non-member rivals. Finally, *Entry* refers to a clause that stipulates how to react to entrants into the industry.

In the rest of the paper, we use these four economic dimensions, $d \in$ {MPA, ICC, ICO, ECC} to organize the contracts and to sketch their anatomy.

4.2   Contract usage

We present the first descriptive statistics in the lower part (Panel B) of Table 1 (see also Appendix 1). The panel reports figures for how prevalent it is for a given cartel to have at least one clause covering economic dimension d in its contract. Almost all cartels (105 out of 109, or 96%) include at least one contractual measure in the MPA dimension, i.e. on how to increase profits.[18] This is not very surprising given the objective of cartels: they must agree on at least one way to increase members' joint profits.

There is much more variation in the ICC, ICO and ECC dimensions. About half (52%) of cartels have one or more contractual clauses for ICC, which are designed to deal with incentive compatibility. This is a relatively low percentage relative to the amount of attention that the economic literature has devoted to the incentive compatibility of cartel agreements. A high percentage (85%) of cartels has at least one contract

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[17] Those cartels that use the ICO clause *Vote* often specify the voting rules to be used: Voting power is distributed according to (sales) quotas or sales (billing), using the 1-share-1-vote-rule, as relative to wages paid, or as a function of the size of the members. As an example, the cardboard cartel used the following voting rule: "Voting power is based on production (volume)".

[18] Of the four who do not have an MPA clause, two are in publishing, one in pharmaceuticals, and the last in jewelry/goldsmith products. For the pharmaceuticals cartel, agreeing on how to raise profits was probably unnecessary given that the industry was heavily regulated (including prices), although one could think that they could have used a *Non-competition/specialization* clause for example.

clause designed to detail cartel organization (i.e., in the ICO dimension). Finally, some three quarters (73%) of cartels went through the trouble of taking into account external threats (ECC) in their contract.

The lower panel of Table 1 also reports descriptive statistics on the fraction of all possible contract clauses that cartels use in a given economic dimension of the contract, conditional on having at least one clause in the dimension. The first row tells us that those cartels that include at least one MPA-related clause in their contract use on average 30% (i.e., roughly two out of the six possible) clauses to specify how profits are to be increased. The fraction of clauses in the ICC dimension, conditional on usage, is 40% out of four possible clauses. Those cartels that contractually specify something about how the cartel is organized use roughly half of the available five measures. Finally, we find that cartels use, on average, less than half of the three contract clauses available to deal with external threats.

Table 1 is consistent with cartels economizing on contracting and adopting an incomplete contracting approach. Cartels appear to use the four economic dimensions selectively. The intensity of usage is not particularly high in any of the four economic dimensions, suggesting that a few contract clauses in a given economic dimension are deemed enough.[19] This is in line with the theory on endogenous contracts which suggests that cartels economize on contract clauses (see Section 2.2).

[TABLE 2 HERE]

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[19] This does not mean, say, that the 48% of cartels not using an ICC clause would not have taken care of the incentive compatibility of their cartel arrangement. It may merely mean that they found the costs of using an explicit contractual clause for the incentive compatibility higher than the benefits such a clause would bring. It is also possible that other dimensions of the contract made having an explicit incentive compatibility clause unnecessary. The cement cartel in the data may serve as an example: the two firms agreed on geographical market allocation. Given the locations of their production facilities, this may have made the use of explicit incentive compatibility clauses unnecessary as (apart from maybe at the border of their allocated regions), the only way to cheat on the contract on a large scale would be to open a production facility in the other firm's territory. This would be easy to verify.

To describe the data further and to shed light on the relative importance of the four economic dimensions, Table 2 takes a *contract design* to be a four-tuple {MPA, ICC, ICO, ECC}, where each element takes the value 1 if the contract of a cartel has at least one contract clause that belongs to the corresponding dimension. This means that for the purposes of Table 2, we view the cartels as having the choice of choosing any of the 15 possible combinations of the four dimensions available to them.[20] As the first column of the table shows, only ten basic contract designs can be identified from our data. The next columns show that 39% (42 out of 109) cartels use the most popular contract design, which covers each of the four economic dimensions. The second most popular one is used by 27% (29 out of 109) cartels and it covers all other dimensions *but* the ICC dimension emphasized in economic research. The three most popular contract designs are all fairly comprehensive, covering at least three of the four dimensions. They are chosen by 73% (80 out of 109) of the cartels, which means that the distribution of contract designs is skewed.

In sum, the descriptive statistics of Table 1 and 2 show that almost all contracts have at least one profit (MPA) clause, making it – unsurprisingly – a fundamental building block of cartel contracts. However, there is a lot of concentration and cartels use the remaining three economic dimensions – ICC, ICO and ECO – quite selectively.

5 Analysis of contracting approaches

The descriptive statistics on the basic features of the contract data suggest that we should take a closer look at the MPA, i.e., how cartels try to raise profits and, in particular, whether this choice has implications to the rest of the contract. This section therefore aims at identifying *contracting approaches* of cartels. We do so by looking for con-

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[20] There are at most $2^4 - 1 = 15$ distinct contract designs that we *could* observe. The space of the contract designs is conditional on the number of underlying metrics and is here defined by the four economic dimensions.

tract clauses that are prevalent and that consistently appear together both within and across the four economic dimensions.[21]

5.1   How do cartels raise profits?

We start by taking a look at how prevalent the various MPA clauses are (Table 3) and at their unconditional correlations (Table 4).

Table 3 shows that *Pricing*, *Market allocation*, *Non-competition/specialization* and *Technology* are more common than *Efficiency* and *Non-price clauses* in our sample. Table 4 shows, in turn, that out of these more common clauses, *Pricing* is negatively (and mostly significantly) correlated with the other, more common MPA clauses. This is suggestive of *Pricing* being a gross substitute for the other MPA clauses. *Market allocation* is not correlated with the other more common clauses. Finally, *Non-competition/specialization* and *Technology* are positively correlated. This correlation structure can also be found once we condition on observable cartel characteristics (see Section 6).

[TABLES 3 AND 4 HERE]

Figure 2 displays the most frequent combinations of the MPA clauses. As the figure shows, 32% of the contracts use only *Pricing* and 16% use a combination of *Non-competition/specialization* and *Technology*. The third most common combination is *Pricing* and *Non-price*. In total, these most typical combinations are used by 62% of the cartels.

[FIGURE 2]

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[21] When such patterns are present, they are indicative of gross complementarities (or gross substitutability). We use terms "gross complementarities" and "gross substitutes" to make it clear that our data are not rich enough for us to test explicitly for the presence of complementarities among the contract clauses. The clustering patterns that we find may therefore mirror real complementarities of contract clauses, affiliated but unobserved net returns to their adoption and/or higher order complementarities (i.e., chain reactions due to interaction of pairs of clauses when there are more than two endogenously chosen clauses in the contract); see, e.g., Arora (1996), Athey and Stern (1998) and Kretschmer, Miravete and Pernias (2012) for discussion.

The above patterns suggest the existence of three MPA-driven contracting approaches. The three contracting approaches are built around the most prevalent MPA clauses, with their cores referring to *Pricing* (often together with *Non-price*), the amalgam of *Non-competition/specialization* and *Technology,* which are highly correlated with each other (we henceforth refer to this amalgam as *Non-Comp-Tech*), and *Market allocation*.[22] *Market allocation* is less commonly used than *Non-Comp-Tech.*

Seen this way, we find that cartels use three main approaches to raise joint profits that appear to be gross substitutes. We have verified the existence of these main contracting approaches using formal cluster analyses (see Appendix 2).

5.2   How do cartels deal with instability?

Table 5 explores whether the various instability clauses are systematically associated with the MPA clauses. We display the unconditional correlations of the various MPA clauses both with the three economic dimensions (ICC, ICO and ECC) and also with the individual clauses of which they consist.

We concentrate first on whether the contracts include any ICC, ICO or ECC clauses and on how this usage is associated with the main MPA clauses. As the table shows, the three main MPA contract clauses each have a particular correlation structure with the rest of the contract. *Pricing* and *Market allocation* are positively correlated with the use of ICC. In contrast, *Non-Comp-Tech* is negatively correlated with the use of ICC and ICO but positively with the use of ECC. As monitoring should be easier when agreeing not to compete or to specialize (*Non-Comp-Tech*), the negative correlation with ICC seems natural. The unconditional correlations of the MPA clauses with the individual ICO, ICC and ECC clauses reveal more heterogeneity, but are broadly

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[22] This view is strengthened when one compares the use of *Pricing*, *Market allocation* and *Non-competition/specialization* to the use of the other three MPA clauses. Of the 105 cartels that use at least one MPA clause, 99% (=104/105) use at least one of *Pricing*, *Market allocation* and *Non-competition/specialization*, whereas only 47% (= 49/105) use at least one of the remaining three.

consistent with these patterns. These findings imply that choosing one of the three main MPA clauses has implications to the rest of the contract and suggest three basic contracting approaches. To verify this, we also tested whether the clusters (see Appendix 2), which build around the three main MPA approaches, are statistically different in terms of ICO, ICC, and ECC. They are.

[TABLE 5 HERE]

To check that the above observations are not an artifact of how we have approached the data, we also analyze the structure of the 18 contract clauses without first assigning them into the four economic dimensions. In our data, only 80 unique contract types can be observed in the larger 18-dimensional contracting space. This confirms that only a small fraction of all potential contract types is used. Moreover, the most popular contract type in the space of 18 contract clauses is used by 8% (9/109) cartels. In line with our earlier analysis along the four economic dimensions, the most popular contract type spans all four dimensions. The second most popular contract type spans three of the four economic dimensions and is used by 5% (5/109) of the cartels. Again, in line with our previous results, but surprisingly given the existing literature, it contains no ICC clauses. Defining contracts to be close when they differ in at most the use of two clauses, we find that 31% (34/109) of the cartels use one of the two most popular contracts, or contracts close to them.[23]

5.3 Summary of the contracting approaches

We find that that all cartels agree on some mechanism to raise joint profits, but use different approaches. The most commonly used MPA-clauses appear to be gross substi-

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[23] The most complicated contract uses 78% (i.e., 14 out of 18) of the contract clauses. This cartel was a joint sales organization of plastics manufacturers. The four clauses this cartel did not use are *Non-price*, *Monitoring*, *Meeting* and *Entry*. There are six cartels that only use one clause. They are: a cement cartel that used *Market allocation* (geographic territories); a cartel on manufacturing of bicycle parts (*Non-competition/specialization*); a cartel on steam boiler production (*Pricing*); a cartel on manufacturing of metallic construction items (*Pricing*); a cartel on manufacturing of leather bags and other leather apparel (*Pricing*); and a cartel on manufacturing of made-up textile goods except wearing apparel (*Pricing*). On the other hand, the simplest contracts use only one of the MPA clauses.

tutes, i.e., they are not used consistently together. Moreover, choosing any one of them has implications to the rest of the contract: *Pricing* and *Market allocation* are positively correlated especially with ICC, and *Non-Comp-Tech* appears to have gross complementarities with ECC. This correlation structure suggests that there are three main contracting approaches that cluster around the most prevalent MPA clauses.

6 Contract heterogeneity

In this section we study how observable cartel- and industry characteristics are related to the cartel contracts and to their correlation structure. We do it in two ways. First, we consider the observable determinants of the 18 contractual clauses. Second, we redo the correlation analysis of the previous section to check the extent to which the unconditional correlation structure between the various contract clauses can be explained away by the observables.

6.1 Observable heterogeneity in cartel contracts and contracting approaches

We report here results from Probit models where the dependent variables are the 18 contractual clauses of which the four economic dimensions consist. These estimations allow us to directly study how the use of a certain contract clause is associated with observable industry and cartel characteristics.[24]

The key explanatory variables are the number of cartel members and the indicator that measures product differentiation (*Homogenous_d*) in the industry. The median

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[24] We would like to point out two things about these Probit regressions: First, our analysis is related to Taylor (2007), who regresses cartel codes on a number of observables, such as the number of firms, industry size, available substitutes and indicator variables for homogenous goods and ease of entry. However, his focus is different. He tries to uncover whether there exists a potential bias in his sample of industries, i.e., the industries that made the choice to apply for be part of the NIRA system might differ from those that did not. To make sure that this is not a problem he runs Probits to see whether these industry characteristics indeed are correlated with the codes chosen by the cartels. The second point that we would like to point out about the Probit models is that an alternative would be to follow the discrete choice approach (e.g. McFadden and Ruud 2000) of treating the different potential cartel agreements as different "products" in a choice set, from which each cartel chooses the one that maximizes its utility. This alternative is not available to us, because the size of the choice set is large relative to the number of cartels we observe.

number of cartel members in the sample is 4 (see Appendix 1). About 44% of the cartels operate in an industry that produces homogenous goods.

We also control for other industry characteristics and the state of the macroeconomy at the time of writing the contract. The industry characteristics are the gross value of production (GVP), the (raw) material cost divided by GVP, the ratio of blue-collar hours to GVP, and the number of plants in the industry, all measured at the 4-digit industry classification of the cartel. All industry variables are measured one year prior to the cartel registering. We include the following macro variables: HP-filtered GDP and the absolute values of the positive and negative shocks to GDP. By using these three variables we can separately control for the level of GDP and positive and negative shocks to GDP. We also include the year of registration to capture unobserved time-specific determinants of cartel contracts.[25]

Tables 6 and 7 present the average marginal effects for cartel size and the homogenous industry dummy for the MPA clauses and the ICC, ICO, EEC clauses, respectively (for the marginal effects of the economic- and industry variables, see Appendix 3). In both tables, the regressions in Panel A only include the number of cartel members and *Homogenous_d* as the explanatory variables. For Panel B, we include the other control variables.

[TABLES 6 and 7 HERE]

Cartel size

Market allocation is uncorrelated, *Pricing* positively correlated (though not when controls are used) and *Non-Comp-Tech* negatively associated with cartel size. This suggests

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[25] We lack information on the number of members for two (pricing) cartels and on a small number of industry characteristics at the four digit industry level. To keep the sample unchanged, we use imputed values. For the industry characteristics, they are the predicted value of the 4-digit value, the prediction taken from a regression of the 4-digit value of the industry characteristic on the 2-digit value, measured in the same year. For those couple of observations where we also lack the 2-digit information and for the two pricing cartels, we use the (4-digit) median. Our qualitative results are robust to excluding the controls with missing values or to excluding the two pricing cartels with missing values from the estimating sample.

that the way in which a cartel decides to increase profits and, by implication, its chosen contracting approach, is related to the number of cartel members.

Turning to the instability clauses, we find (from the last three columns of Table 6) that the three economic dimensions (ICC, ICO, ECC) are significantly and positively affected by cartel size. As Table 7 shows, the picture is somewhat richer at the level of individual clauses. In particular, the number of members is positively and significantly correlated with many ICO clauses and with *New members* -clause, but negatively with *Non-cartel supply* and *Entry*. These correlations are intuitive: Large cartels have developed rules for new members, and are less worried about entry and supply outside the cartel.

Product differentiation

The homogenous goods-dummy is significantly positively associated with the use of *Market allocation* (Table 6). The association is less clear and less robust with the rest of the clauses. In the raw data, 77% of the *Market allocation* cartels are found in homogenous goods industries (see Appendix 1).

The relation between the homogenous goods-dummy and various ICC, ICO and ECC clauses is, in general, weak. As Table 7 shows, an exception to this pattern is that the homogenous goods-dummy is positively and significantly associated with ICC clauses *Monitoring* and *Enforcement*, irrespectively of whether the controls are included or not.

6.2   Conditional correlations

Here we redo the correlation analysis of the previous section (i.e., Tables 4 and 5) by studying the matrix of correlation coefficients between the *generalized residuals* of the estimated Probit models. This conditional correlation analysis allows us to check the extent to which the unconditional correlation structure between the various contract clauses is explained by the observables.

The correlations of the generalized residuals are displayed in Table 8. We have two main findings. First, the qualitative correlation structure across the MPA clauses stays more or less the same. Second, the relations between the MPA clauses and the instability clauses change. The unconditional correlations (Table 5) suggested many systematic patterns across each of the three most commonly used MPA clauses and the instability clauses. Now these patterns disappear or get weaker: In particular, after conditioning, *Pricing* is less correlated with ICC, ICO and ECC, but the corresponding correlations with *Market allocation* are largely unchanged. *Non-competition/specialization* is still negatively correlated with ICO, but is not as correlated with ICC and ECC anymore. It is important to note that when we exclude the number of members and *Homogenous_d* from the Probit specifications, the correlations between the generalized residuals are again close to the unconditional correlations. This suggests that the correlations in the raw contract clause data were driven by these two observable characteristics.

[TABLE 8 HERE]

6.3   Summary of the heterogeneity in cartel contracts

We find that the size of the cartel is associated with the choice of how to raise profits, being (weakly) positively correlated with the use of *Pricing*, negatively with the amalgam of *Non-Comp-Tech*, and uncorrelated with *Market Allocation*. The homogenous goods-dummy is positively correlated with *Market Allocation*. Cartel size is mostly positively associated with the use of instability clauses in ICC, ICO and ECC.

The relationship between the three most commonly used MPA clauses is robust to cartel-/industry heterogeneity and business cycle conditions. However, the relations between the three most commonly used MPA clauses and the instability clauses get weaker. It is thus the observables, in particular the number of members and the homogenous goods -dummy, that drive many of the unconditional correlations.

7 Complexity and stability of contracts

The above results already speak to the variation in the complexity of contracts. In this section we explore further the complexity and stability of cartel contracts. We do so by regressing indicators of complexity and stability on a set of cartel and industry variables and by summarizing three case studies that we have conducted.

7.1 Regression analysis

We employ two measures of "complexity": the number of clauses used by the cartel (mean = 5.60) and, following Taylor (2007), the length of the contract measured in pages (mean = 3.32). Our measure of contract stability is the number of times the cartel registered a change of contract with the Registry (mean = 1, max=14). This measure is related to contract complexity and mirrors how stable the contracts were from a contracting point of view, i.e., how the characteristics of the cartel, the initial contract, and the environment at the time the initial contract was registered affect the number of times the contract was changed.

Table 9 presents eight Poisson regressions that shed light on the complexity of cartel contracts. There are three dependent variables: the number of clauses in a contract, the number of pages of the contract and the number of contract changes (see Appendix 1 for a distribution of the number clauses and contract changes). The explanatory variables include the number of members and the homogenous goods-dummy, as well as the same controls as used in the Probit models earlier. In addition to these, we include the MPA clause indicators and ICC, ICO and ECC -measures in some of our regressions.

[TABLE 9 HERE]

Three main findings can be made from Table 9. First, the number of clauses is positively correlated with the number of members, suggesting that large cartels have more comprehensive and complex contracts (columns 1 and 2). The number of pages is

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also positively correlated with the number of members, but this coefficient becomes insignificant when we include controls (see columns 3, 4 and 5). A potential explanation for the positive association is that an increase in the number of members raises the cost of relying on informal agreements as opposed to relying on formal contract clauses. Second, the degree of product differentiation is not correlated with the number of clauses, but cartels in homogenous goods industries have shorter contracts. These findings could be explained by homogenous goods industries having less need to contract on product characteristics and quality, as conjectured already by Stigler (1964). Third, as also the raw data suggest (see Appendix 1), we find that especially cartels using *Market Allocation* contracts write longer contracts. This suggests that these forms of cooperation are more complicated than, e.g., the agreements to not compete or to specialize.

Turning then to columns 6, 7 and 8 of Table 9, we find that the number of contract changes seems initially positively correlated with both cartel size and the homogenous goods-dummy. These results however disappear when we include controls. *Pricing* cartels and cartels that have *Efficiency*-clauses have significantly more contract changes and *Non-Comp-Tech* cartels fewer contract changes. The first result is not entirely surprising, as some of the contract changes are about changes of prices. *Market Allocation* cartels are no different from the other MPA contract types.

7.2   Case studies

We have conducted case studies of one *Pricing* cartel (the match producers cartel), one *Market allocation* cartel (the cement cartel), and one *Non-comp-Tech* cartel (the plywood box cartel). Our choice rule was to choose the earliest registered cartel in a homogenous goods industry that uses only one of the three aforementioned main MPA clauses. As we describe in more detail in Appendix 4, all these cartels used relatively short and simple contracts. This is consistent with the above results on contract com-

plexity, as all three have a small number of members and are in homogenous goods industries.

8   Discussion

In this section, we discuss briefly three issues: First, do our results generalize to beyond the sample of 109 manufacturing industries and cartels? Second, how do our results compare to what is known about cartel contracting in other institutional environments and countries? Third, we discuss the relationship between legal and illegal cartel contracts.

Our analysis has focused on the 109 nationwide manufacturing cartels that were the first registered cartels in a given (3-digit) industry. To check how representative this sample is, we use more limited information from a larger sample of 902 legal cartels from the same era. This sample covers both manufacturing and non-manufacturing (e.g., mining, retailing) industries and contains cartels that were registered later than the cartels in our baseline sample. The larger sample contains information only on the use of *Pricing*, *Market-allocation*, and *Non-competition/specialization*. In this sample, 96% of the manufacturing cartels use at least one of these three most common MPA clauses. Moreover, in the large sample, 37% of the manufacturing cartels use *Pricing* as opposed to the 58% of cartels in our sample; 27% use *Market-allocation* (27% in our sample) and 52% use *Non-competition/specialization* (39%). Two of the three correlations between these MPA-clauses are negative and significant (only the correlation between Pricing and Market-allocation is positive (0.03) and insignificant). The differences to the cartels *outside* manufacturing are larger: These use *Pricing* clearly more often (78%), and *Market-allocation* and *Non-competition/specialization* less often than the manufacturing cartels (6% and 22%). This seems plausible, because it is likely that retailers and wholesalers use more frequently various pricing schemes, such as list prices, retail price maintenance arrangements, etc. There is thus a reason to think that non-

manufacturing cartels use different contracts than manufacturing cartels, but within manufacturing our sample seems representative of the larger sample.

Our findings augment those in the existing literature. Suslow and Levenstein (2011), using a sample of illegal international cartels report, that a much higher percentage (80% against our 27%) use market allocation, mirroring e.g. the need for delineation of the global market into national or regional markets. At the same time, earlier studies looking at illegal U.S. cartels report numbers very similar to ours.[26] Further, in Levenstein and Suslow's (2011) sample 31% of cartels involve a trade sales association (52% in our data; the older studies cited in footnote 26 report 29-44%). One third of their cartels adopt some compensation scheme, in our data, the clause *Enforcement* comes closest; it is adopted by 12% of cartels. However, 31% adopt *Expel* and 15% adopt *Fine*.[27]

Comparing the characteristics of the cartels in our sample to those studied by Harrington (2006) it is important to keep in mind that while we look at contract clauses, Harrington analyzes practices, and the two need not necessarily coincide. In any case, we find more heterogeneity. All cartels in Harrington's sample agree on prices, and, though this is more difficult to judge, it seems that the cartels in Harrington's sample used more complex organizations than the average cartel in our sample. The former could be the result of the international illegal cartels being unable to use market allocation, as it could have led to a higher detection probability. The latter may be explained by the fact that international cartels need a more complex organization than national cartels.

Our contract characteristics are not easily compared to those recorded by Taylor (2007). Our results on the complexity of cartel contracts are however in line with his

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[26] See also Levenstein and Suslow 2006, Table II: Hay and Kelley (1974) report that 35% use market allocation; Fraas and Greer (1977) 26%, Posner (1970) 26% and Gallo et al. (2000) 27%.

[27] "Disciplinary or Coercive Practices" and/or "Exclusion" are adopted by 5% of the cartels in Hay and Kelley and by 12% in Fraas and Greer.

results. Using data on U.S. legal cartels from the 1930s (the National Industrial Recovery Act), Taylor also found a positive but insignificant correlation between cartel size and number of pages, and no significant relationship between pages and degree of product differentiation.

As we already discussed, the cartels in our sample were legal, but apparently they hardly ever used the legal system to enforce their cartel contracts, nor was the enforceability clear ex ante. Thus, there were few reasons at the initial contracting stage to consider the degree of verifiability of the various clauses in the court of law. Still we observe that they economize on the number of clauses. Using the terminology of Kaplow (2011a, pp. 803), the contracts we have studied can be seen as an exchange of promises and, perhaps, as a means to communicate the intended behavior of cartel members. It seems clear that the need of *illegal* cartels to conceal their agreements and behavior will lead to further endogenous incompleteness of contracts, because the participants have a strong incentive to strategically reduce the ability of a legal court to verify their concerted actions (see Kvaløy and Olsen 2009 and also Kaplow 2011a, pp. 758-765). From this point of view one could think that the contracts we've studied are the type of contracts illegal cartels would like to write, *had that no legal consequences*. This means that observed differences between contracts of legal and illegal cartels are likely to be due to the competition law regime that the latter face. The reasoning behind this statement is that the profit, incentive and organizational issues illegal cartel face, as well as those relating to changes in the external environment, are similar to those faced by the legal cartels that we have studied.

9   Conclusions

We have followed a four-step research approach to provide an anatomy of cartel contracts. In line with the theory of endogenous incomplete contracts we find cartels to economize on contract clauses. We find three basic contracting approaches: cartels ei-

ther agree on prices, allocate markets, or use some type of non-competition/specialization clause to raise profits. These are gross substitutes and their correlation structure is not explained by the number of members in the cartel and whether the industry is producing homogenous goods. Choosing one of these approaches has implications to the rest of the contract.

Our key findings are the following:

- Cartels that use *Pricing* clauses are the most common collusive scheme. *Pricing* clauses are frequently combined with *Non-price* restrictions, such as clauses on add-ons, bundling and quality. Use of *Pricing* is positively correlated with incentive compatibility (ICC) and organizational clauses (ICO), but negatively with clauses on external threats (ECC). However, these correlations get substantially weaker when they are conditioned on the number of members and whether cartel comes from a homogenous goods industry. In terms of contract dynamics, contract changes are seen more often in *Pricing* cartels.

- Cartels frequently use *non-competition/specialization* clauses, which often entails coordination on the positioning in the product space (i.e., who specializes on what). The use of non-competition/specialization clauses appears to be more common than (pure) market allocation schemes, is associated with smaller cartels, and is often related to sharing of technological knowledge. These findings are consistent with the conjecture of Stigler (1964) about the many facets of collusive arrangements. When non-competition/specialization clauses are used, the cartel contract is updated less frequently.

- *Market allocation* cartels use more often incentive compatibility (ICC) clauses, are more complex (use longer contracts) and are more likely to appear in homogenous goods industries. They are the least common of the three main contracting approaches.

Our findings suggest regularities in cartel contracts that can be exploited by competition authorities: In terms of deciding where to look for cartels and collusion (e.g. Symeonidis 2003) and, in particular, in terms of what types of concerted action or horizontal agreements to expect and to search for. This knowledge should ultimately increase the likelihood of courts making a proper ruling in cases involving price-fixing and other prohibited horizontal agreements (Kaplow 2011a,b).

Our results suggest directions for future empirical and theoretical work: First, our results suggest that there are systematic differences in how collusion is organized in different types of markets, and by cartels of different sizes. These differences will with high likelihood have an impact on the behavior and effects of the cartel. This implies that testing collusive effects and different models of collusion would benefit from explicitly taking these systematic differences into account.

Second, it seems fair to say that the existing theoretical literature has focused on monitoring and punishment schemes, but neglected the broader characteristics of how collusion is organized. For example, the prior literature has not systematically considered why and when various non-competition/specialization schemes provide a substitute for price-fixing or market allocation. Our results suggest that coming up with ways of avoiding competition through specialization or diversification in product space may become increasingly hard as the number of members increases. Moreover, our finding that cartels in homogenous goods industries are more likely to use market allocation begs for a theoretical analysis. A possible reason for the positive correlation could be that it is easier to divide markets e.g. geographically when the product is homogenous and thus more easily verifiable. Another explanation could be that many homogenous goods industries sell to other firms instead of consumers. In such markets prices aren't necessarily observed, making it harder to monitor coordination on prices than, e.g., an agreement on spatial market allocation.

More generally, we believe that our results can be used to build models that in equilibrium deliver one of the types of cartel contracts observed in our data under the assumption that there is no competition authority. The environment can thereafter be changed (by, e.g., introducing a competition authority, modelled as a detection probability and an associated fine) to study what type of a cartel agreement arises in the new equilibrium and how cartels adapt.

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Tables and Figures

Figure 1: The four-step research approach

Step 1: Quantification of Cartel Contracts
- Use economic theory to identify the features that firms agree on when they aim to collude.
- Quantify the means by which concerted actions are pursued.

Step 2: Identification of Contracting Approaches
- Identify the primary contract clauses that describe how cartels try to raise profits. Check the robustness of the conclusions using e.g. cluster analysis.
- Explore the rest of the contract and how those contract clauses correlate with the primary contracting clauses.

Step 3: Analysis of Contract Heterogeneity
- Study the determinants of the contract clauses.
- Check to what extent the observables explain the correlation structure of the contract clauses.

Step 4: Analysis of Contract Stability
- Explore the complexity and stability of cartel contracts .

Table 1: Economic dimensions and contract clauses

Panel A: Variable descriptions

Economic dimension #1: Market Power Attributes (MPA) -- 6 clauses

Pricing	*= 1 if the contract refers to prices, pricing rules, discount rules and/or rules of delivery and payment.*
Market allocation	*= 1 if the contract refers to sales quotas or market shares, exclusive territories, or allocation of customers among the members.*
Efficiency	*= 1 if the contract stipulates, e.g., that sales and/or production should be allocated according to efficiency.*
Technology	*= 1 if the contract refers toabout sharing of technological knowledge such as patents or blueprints.*
Non-price	*= 1 if the contract mentions any non-price restrictions, like add-ons, bundling, and quality.*
Non-comp./spec.	*= 1 if the contract stipulates that the members are to specialize in one way or the other, or agree to "not compete" in a given market.*

Economic dimension #2: Incentive Compatibility Constraint (ICC) -- 4 clauses

Monitoring	*= 1 if the contract has a clause on how the members monitor each other.*
Enforcement	*= 1 if the contract stipulates how to handle situations where a member has deviated or mentions price wars, retaliation, etc.*
Expel	*= 1 if the contract includes rules on how to expel a member if rules are broken.*
Fine	*= 1 if the contract includes clauses on monetary fines for a company that violates the contract.*

Economic dimension #3: Internal Cartel Organization (ICO) -- 5 clauses

Meeting	*= 1 if the contract stipulates whether, and if so, how often, the members are to meet.*
Dispute-resolution	*= 1 if the contract specifies a way in which disputes among members are to be resolved.*
Structure	*= 1 if the cartel has a formal structure, such as an association or a limited liability company to organize itself.*
Vote	*= 1 if the contract specifies a voting procedure.*
Sales	*= 1 if the cartel has formed either a trade or a sales association.*

Economic dimension #4: External Cartel Contract (ECC) -- 3 clauses

New members	*= 1 if the contract specifies a policy on how to accept new members.*
Non-cartel supply	*= 1 if the contract specifies how to deal with supply from non-member rivals.*
Entry	*= 1 if the contract stipulates how to react to entrants into the industry.*

Table 1, continued

	Sub-panel (i) Any clause used?		Sub-panel (ii) If used, how often?	
	# of cartels	Freq.	Max # of clauses	Freq.
MPA	105	0.96	6	0.30
ICC	57	0.52	4	0.39
ICO	93	0.85	5	0.49
ECC	80	0.73	3	0.43

Notes: In sub-panel (i), we report the number of cartels and the associated frequency that use at least one contract clause in each of the four economic dimension. In sub-panel (ii), we report the average of the number of clauses used divided by the maximum number of clauses, conditional on using at least one clause in the dimension.

Table 2: Contract designs observed in the data

	Sub-panel (i)			Sub-panel (ii)				Sub-panel (iii)			
Contract design	n	Freq.	Homogenous	MPA usage	ICC usage	ICO usage	ECC usage	MPA usage intensity	ICC usage intensity	ICO usage intensity	ECC usage intensity
1	42	0.39	0.50	1	1	1	1	0.30	0.38	0.58	0.38
2	29	0.27	0.48	1	0	1	1	0.32	-	0.39	0.46
3	9	0.08	0.56	1	1	1	0	0.30	0.50	0.49	-
4	9	0.08	0.11	1	0	1	0	0.33	-	0.36	-
5	9	0.08	0.44	1	0	0	0	0.22	-	-	-
6	4	0.04	0.25	1	0	0	1	0.29	-	-	0.58
7	3	0.03	0.00	0	1	1	1	-	0.33	0.73	0.44
8	2	0.02	1.00	1	1	0	0	0.25	0.25	-	-
9	1	0.01	0.00	1	1	0	1	0.33	0.25	-	0.67
10	1	0.01	0.00	0	0	1	1	-	-	0.60	0.33

Notes: Sub-panel (i) reports which combinations of {MPA, ICC, ICO, ECC} are used in the data and how common they are. Sub-panel (ii) shows how the contracts look like. Sub-panel (iii) reports the average of the number of clauses used divided by the maximum number of clauses, conditional on using at least one clause in the dimension.

Table 3. Prevalence of MPA clauses

MPA clause	Sample		
	All	Homogenous	Non-homogenous
	Mean	Mean	Mean
Pricing	0.578	0.525	0.646
Market allocation	0.266	0.131	0.438
Efficiency	0.083	0.098	0.063
Technology	0.284	0.344	0.208
Non-price	0.147	0.115	0.188
Non-comp./spec.	0.385	0.426	0.333
# of cartels	109	48	61

Notes: The table reports the fraction of cartels that use the various MPA clauses for the full sample, as well as for the cartels coming from homogenous goods and non-homogenous goods industries.

Table 4. Unconditional correlations of MPA clauses

MPA clause	Pricing	Market allocation	Efficiency	Technology	Non-price
Market allocation	-0.116	1			
Efficiency	-0.216**	0.272***	1		
Technology	-0.532***	0.082	0.180*	1	
Non-price	0.302***	0.044	-0.124	-0.147	1
Non-comp./spec.	-0.698***	0.035	0.310***	0.546***	-0.222**

Notes: The table reports pairwise correlations for the MPA clauses. Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively.

Figure 2: Most frequent combinations of the MPA clauses
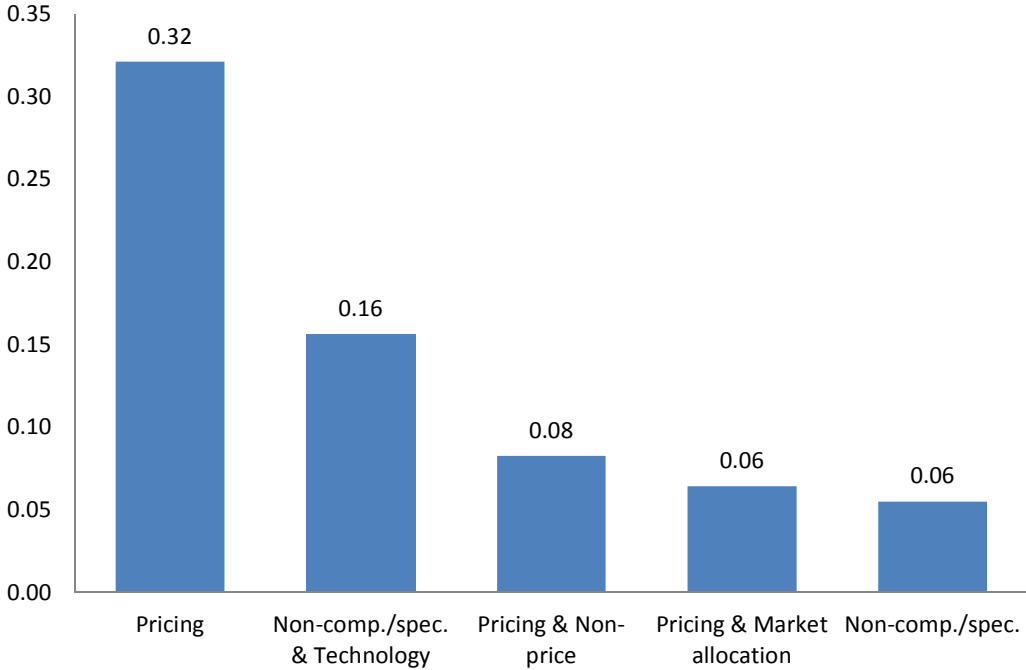
Table 5. Unconditional correlations between MPA clauses and other economic dimensions

	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.
ICC (count)	0.236**	0.448***	0.022	-0.151	-0.002	-0.368***
ICC_1 (=1 if ICC > 0; 0 otherwise)	0.262***	0.284***	0.020	-0.212**	-0.019	-0.414***
Monitoring	0.173*	0.443***	-0.012	-0.114	0.011	-0.266***
Enforcement	0.085	0.483***	0.198**	-0.044	0.087	-0.175*
Expel	0.215**	-0.002	-0.058	-0.117	-0.111	-0.289***
Fine	0.09	0.279***	-0.030	-0.089	0.048	-0.169*
ICO (count)	0.317***	0.226**	0.050	-0.236***	-0.012	-0.370***
ICO_1 (=1 if ICC > 0; 0 otherwise)	-0.0395	0.132	0.124	0.089	-0.048	0.009
Meeting	-0.014	0.121	0.152	-0.115	-0.124	0.036
Dispute-resolution	-0.357***	0.339***	0.233**	0.278***	0.001	0.304***
Structure	0.316***	0.074	-0.054	-0.251***	-0.145	-0.371***
Vote	0.436***	0.082	-0.070	-0.284***	0.042	-0.412***
Sales	0.486***	0.076	-0.047	-0.334***	0.137	-0.565***
ECC (count)	-0.293***	0.086	0.028	0.293***	-0.111	0.263***
ECC_1 (= 1 if ECC > 0, 0 otherwise)	-.178*	0.034	-0.046	0.195**	-0.044	0.093
New members	0.395***	-0.082	-0.095	-0.406***	-0.055	-0.500***
Non-cartel supply	-0.529***	0.212**	0.155	0.587***	-0.032	0.561***
Entry	-0.380***	-0.015	-0.030	0.313***	-0.099	0.417***

Notes: The table reports for each MPA clause, pairwise correlations with ICC, ICO and ECC as well as with the individual clauses of which they consist. Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively.

Table 6. Marginal effects of MPA contract clauses and ICC, ICO and ECC

Panel A - Probit	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.	ICC	ICO	ECC
Log(members)	0.201***	-0.032	-0.080*	-0.202***	-0.037	-0.316***	0.257***	0.085**	0.076*
	(0.053)	(0.030)	(0.042)	(0.072)	(0.028)	(0.072)	(0.032)	(0.036)	(0.039)
Homogenous_d	0.134*	0.281***	-0.038	-0.128	0.066	-0.084	0.118	0.005	0.033
	(0.075)	(0.067)	(0.065)	(0.084)	(0.058)	(0.088)	(0.078)	(0.065)	(0.059)
Control variables	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pseudo R2	0.189	0.111	0.101	0.193	0.029	0.353	0.262	0.063	0.032
Chi2-test_#1	<0.01	<0.01	0.110	0.079	0.103	0.018	<0.01	0.025	0.140
Observations	109	109	109	109	109	109	109	109	109
Panel B - Probit	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.	ICC	ICO	ECC
Log(members)	0.041	-0.059	-0.086**	-0.105***	-0.070**	-0.134**	0.261***	0.195***	0.159***
	(0.038)	(0.042)	(0.040)	(0.038)	(0.029)	(0.053)	(0.038)	(0.048)	(0.038)
Homogenous_d	0.015	0.219***	-0.066	-0.035	-0.052	-0.028	0.125	0.003	0.116**
	(0.061)	(0.067)	(0.062)	(0.072)	(0.071)	(0.095)	(0.098)	(0.059)	(0.057)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R2	0.413	0.174	0.286	0.432	0.422	0.561	0.312	0.322	0.198
Chi2-test_#1	0.552	<0.01	0.088	0.027	0.047	<0.01	<0.01	<0.01	<0.01
Chi2-test_#2	<0.01	0.024	0.022	<0.01	<0.01	<0.01	0.011	<0.01	<0.01
Observations	109	109	109	109	109	109	109	109	109

Notes: The table reports Probit marginal effects and standard errors (in parenthesis). Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively. Chi2-test_#1 tests the joint significance of Log(members) and Homogenous_d. Chi2-test_#2 tests the joint significance of the control variables.

Table 7. Marginal effects of ICC, ICO and ECC contract clauses

Panel A	ICC				ICO					ECC		
	Moni-toring	Enforce-ment	Expel	Fine	Meeting	Dispute-resolution	Structure	Vote	Sales	New member	Non-cartel supply	Entry
Log(members)	0.049*	-0.006	0.203***	0.022	-0.016	-0.055*	0.181***	0.196***	0.227***	0.234***	-0.242***	-0.095***
	(0.026)	(0.015)	(0.016)	(0.022)	(0.021)	(0.029)	(0.038)	(0.037)	(0.042)	(0.032)	(0.053)	(0.025)
Homogenous_d	0.231***	0.154***	-0.073	-0.001	-0.000	0.112	-0.071	-0.015	0.004	-0.072	0.009	0.070
	(0.063)	(0.052)	(0.059)	(0.055)	(0.057)	(0.102)	(0.074)	(0.061)	(0.096)	(0.073)	(0.081)	(0.067)
Control variables	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pseudo R2	0.098	0.084	0.419	0.0082	0.008	0.027	0.198	0.199	0.218	0.395	0.221	0.109
Chi2-test_#1	<0.01	0.0189	<0.01	0.574	0.723	0.078	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Observations	109	109	109	109	109	109	109	109	109	109	109	109

Panel B	ICC				ICO					ECC		
	Moni-toring	Enforce-ment	Expel	Fine	Meeting	Dispute-resolution	Structure	Vote	Sales	New member	Non-cartel supply	Entry
Log(members)	-0.040	-0.056**	0.322***	-0.013	-0.002	0.030	0.252***	0.197***	0.121***	0.217***	-0.121***	-0.032
	(0.030)	(0.023)	(0.046)	(0.022)	(0.015)	(0.021)	(0.037)	(0.042)	(0.046)	(0.032)	(0.040)	(0.019)
Homogenous_d	0.189***	0.099**	-0.052	-0.029	-0.043	0.087	-0.136*	-0.073	-0.130	-0.109*	0.093	0.132*
	(0.046)	(0.041)	(0.075)	(0.057)	(0.059)	(0.086)	(0.080)	(0.065)	(0.101)	(0.065)	(0.076)	(0.073)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R2	0.260	0.236	0.509	0.062	0.265	0.176	0.299	0.269	0.348	0.412	0.363	0.201
Chi2-test_#1	<0.01	0.013	<0.01	0.465	0.796	0.307	<0.01	<0.01	0.066	<0.01	<0.01	0.104
Chi2-test_#2	<0.01	<0.01	<0.01	0.077	0.296	<0.01	0.214	0.080	<0.01	0.105	<0.01	<0.01
Observations	109	109	109	109	109	109	109	109	109	109	109	109

Notes: The table reports Probit marginal effects and standard errors (in parenthesis). Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively. Chi2-test_#1 tests the joint significance of Log(members) and Homogenous_d. Chi2-test_#2 tests the joint significance of the control variables. The regression for Entry is an OLS regression (Linear Probability Model), due to Log(members) being a perfect predictor for Entry = 1 in the Probit.

Table 8. Correlations of generalized residuals of MPA clauses and other economic dimensions

Residual of:	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.
Market allocation	-0.259***	1.000				
Efficiency	-0.033	0.286***	1.000			
Technology	-0.249***	0.225**	0.030	1.000		
Non-price	0.171*	-0.064	-0.050	0.026	1.000	
Non-comp./spec.	-0.448***	0.154	0.154	0.295***	-0.102	1.000
ICC_1	-0.035	0.302***	0.100	0.060	0.037	-0.032
Monitoring	-0.010	0.338***	0.040	-0.014	-0.022	-0.032
Enforcement	-0.024	0.404***	0.231**	0.055	-0.017	-0.020
Expel	-0.067	0.148	0.039	0.104	0.058	0.051
Fine	0.013	0.292***	0.022	-0.001	0.064	-0.091
ICO_1	0.042	0.151	0.124	0.121	0.062	0.055
Meeting	0.137	0.064	0.161*	-0.166*	-0.085	-0.119
Dispute-resolution	-0.269***	0.322***	0.132	0.224**	0.115	0.155
Structure	0.159*	0.171*	0.108	-0.082	-0.226**	-0.209**
Vote	0.271***	0.148	0.143	-0.061	0.020	-0.234**
Sales	0.190**	0.058	0.104	-0.037	0.071	-0.352***
ECC_1	-0.151	0.066	-0.116	0.142	0.180*	0.084
New members	0.156	-0.057	0.102	-0.213**	0.067	-0.243**
Non-cartel supply	-0.227**	0.289***	-0.017	0.377***	0.043	0.272***
Entry	-0.105	-0.040	-0.160*	0.059	-0.014	0.053

Notes: The data refer to generalized residuals from the Probit models. The table reports for the residuals of each MPA clause, pairwise correlations with the corresponding residuals for ICC, ICO and ECC as well as for the individual clauses of which they consist. Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively.

Table 9. Contract complexity and stability

Variables	(1) #clauses	(2) #clauses	(3) #pages	(4) #pages	(5) #pages	(6) #changes	(7) #changes	(8) #changes
Log(members)	0.086***	0.100***	0.132***	0.077	0.086	0.262***	0.103	0.003
	(0.018)	(0.029)	(0.042)	(0.054)	(0.077)	(0.082)	(0.137)	(0.147)
Homogenous_d	0.104	0.053	0.020	-0.166**	-0.155**	0.445**	0.186	0.063
	(0.084)	(0.075)	(0.074)	(0.081)	(0.067)	(0.175)	(0.228)	(0.246)
Pricing	-	-	-	0.342**	0.189	-	1.244***	1.065***
				(0.152)	(0.144)		(0.449)	(0.363)
Market allocation	-	-	-	0.343***	0.352***	-	0.261	0.264
				(0.119)	(0.108)		(0.293)	(0.360)
Efficiency	-	-	-	0.191	-0.037	-	1.044***	1.211**
				(0.118)	(0.128)		(0.402)	(0.574)
Technology	-	-	-	-0.046	-0.187	-	0.225	0.097
				(0.109)	(0.123)		(0.322)	(0.466)
Non-price	-	-	-	0.206*	0.204*	-	-0.476	-0.896**
				(0.122)	(0.115)		(0.322)	(0.411)
Non-comp./spec.	-	-	-	-0.028	0.096	-	-1.113**	-1.047*
				(0.106)	(0.105)		(0.548)	(0.582)
ICC_1 (= 1 if ICC > 0)	-	-	-	0.151*	0.169*	-	0.180	-0.064
				(0.086)	(0.093)		(0.313)	(0.338)
ICO_1 (= 1 if ICO > 0)	-	-	-	0.133	0.281**	-	-0.217	-0.018
				(0.159)	(0.136)		(0.333)	(0.348)
ECC_1 (= 1 if ECC > 0)	-	-	-	-0.063	-0.094	-	-0.392	-0.176
				(0.127)	(0.128)		(0.283)	(0.192)
Controls	No	Yes	No	No	Yes	No	No	Yes
Observations	109	109	109	109	109	109	109	109

Notes: The table reports marginal effects and standard errors (in parenthesis). The standard errors are clustered by the registration year. Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively.

Appendix for online publication

Appendix 1: Further descriptive statistics

Table A1. Conditional medians/means of cartel characteristics

	Members	Duration	Pages	Homogenous goods	# Contract changes	# Clauses
All cartels	4	5	3	0.44	1	6
Conditioning variable						
MPA	4	5	3	0.457	1.029	6
Pricing	7	2	3	0.492	1.524	6
Market allocation	3	5	4	0.724	1.138	8
Efficiency	2	5	4	0.333	0.889	7
Technology	2	5	3	0.322	0.452	5
Non-price	4	1.5	4	0.556	0.938	6.5
Non-comp./spec.	2	5	2	0.381	0.286	5
ICC	7.5	5	3	0.491	1.333	7
ICO	5	5	3	0.441	0.968	6
ECC	4	5	3	0.45	0.863	6

Notes: The numbers presented are the medians of the column variables, conditional on the row variable taking the value one. For homogenous goods and # of contract changes we report the mean.

Table A2. The distribution of #clauses and # contract changes

	# of cartels having:	
Count of clauses or contract changes	clauses	contract changes
0	-	58
1	6	17
2	5	19
3	10	11
4	16	3
5	15	0
6	21	0
7	15	0
8	9	0
9	5	1
10	4	-
11	1	-
12	1	-
13	0	-
14	1	-

Note: Column two displays the number of cartels with a given number of clauses (as given in column one). Column three displays the number of cartels with a given number of contract changes.

Appendix 2: Cluster analysis of contract clauses

In this appendix, we report the results of a series of cluster analyses. The aim of cluster analyses is to determine the natural groupings in a data set. We use the approach to explore the robustness of the three main MPA approaches that we identify in the main text.

We implement four types of cluster analyses. First, we cluster the data on observations, using both (agglomerative) hierarchical and partition clustering methods. These approaches determine, using individual cartels as the object of the clustering analysis, which *cartels* form natural groupings in the data. Using these groupings, we can then examine how the groups differ and, in particular, which MPA clauses the cartels in the different groups use. Second, we repeat the analyses using the two clustering methods, but with the twist that we examine directly the clustering of contract clauses. Here the object of the clustering analysis is the six MPA clauses (i.e., variables) and our interest is in understanding the natural grouping among them, given the contract data that we have.

Agglomerative hierarchical clustering method results in a hierarchy of groups. It begins with single observations and proceeds by combining the closest two. This process is continued till all observations in the data are in the same cluster. Partition cluster method, instead, starts by breaking the data into a number of distinct groups. We use partitioning method called kmeans, which is a commonly used partitioning method.

The methods require that a distance measure for determining similarity is chosen. Similarity measures for binary data ask whether for two observations (variables), the values taken by the variables (observations) match, in the sense that for the two observations (variables), there are many variables (observations) that are one or zero for both of them at the same time. We use the "matching" binary similarity coefficient, which calculates the proportion of matches between the two observations (variables). For the hierarchical clustering method, we also need a measure which determines when two groups are close. To this end, we use single-linkage and average-linkage clustering. The former uses the closest observations of groups to determine which the two closest groups are. In the latter, they are determined the average similarity.

In all what follows, we fix the number of clusters to three or four. This choice was dictated both by our prior views (based on the available economic literature on collusion) and the objective of our clustering exercise. We also explored with certain formal methods to determine the number of clusters. While not entirely conclusive, those did not disagree with our prior views.

The results of the cluster analyses which use the cartels as the unit of analysis are displayed in table A3. The table shows that the cartels have a clear tendency to cluster so that *Pricing* and the amalgam of *Non-competition/specialization* and *Technology* can be identified as independent clusters, though the former appears sometimes together with *Non-price*. *Market allocation* is typically the most dominant MPA-clause in the third emerging cluster of cartel contracts, but both the size of the third cluster and its remaining composition vary slightly, depending on the cluster approach used.

Table A3. Results from cluster analyses

Partitioning (kmeans), # of clusters = 3

Cluster	Freq.	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp./spec.
1	0.12	0.08	1.00	0.46	0.62	0.00	0.85
2	0.26	0.04	0.00	0.11	0.71	0.04	0.96
3	0.62	0.90	0.24	0.00	0.04	0.22	0.06

Hierarchical, # of clusters = 3

Cluster	Freq.	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp./spec.
1	0.58	0.94	0.17	0.00	0.02	0.21	0.06
2	0.02	1.00	1.00	0.00	1.00	1.00	0.00
3	0.40	0.05	0.36	0.20	0.64	0.02	0.86

Partitioning (kmeans), # of clusters = 4

Cluster	Freq.	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp./spec.
1	0.48	0.92	0.00	0.00	0.02	0.19	0.06
2	0.15	0.81	1.00	0.00	0.13	0.31	0.06
3	0.12	0.08	1.00	0.46	0.62	0.00	0.85
4	0.26	0.04	0.00	0.11	0.71	0.04	0.96

Hierarchical, # of clusters = 4

Cluster	Freq.	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp./spec.
1	0.58	0.94	0.17	0.00	0.02	0.21	0.06
2	0.02	1.00	1.00	0.00	1.00	1.00	0.00
3	0.32	0.00	0.29	0.00	0.66	0.03	0.86
4	0.08	0.22	0.67	1.00	0.56	0.00	0.89

Notes: The table reports the size of the clusters and the frequency at which they contain different MPA clauses.

We can summarize the results of the cluster analyses of variables (clauses) verbally as follows: First, *Pricing* typically shows up as an independent cluster. If it does not, it is combined with *Non-price*. Second, *Non-competition/specialization* and *Technology* are grouped together, but never with the other MPA clauses. Third, *Market allocation* either forms an independent cluster, or is combined with *Efficiency* and/or *Non-price*. These groupings square nicely with those shown in table A3.

Appendix 3: Industry- and macroeconomic effects

This appendix reports further information on how we have used industry and macroeconomic variables in the analysis. We report, in particular, how cartel contracts are correlated with industry heterogeneity and the state of the business cycle at the time the cartel is formed. This is motivated by the old question of whether collusion is more likely to be sustained and initiated during booms or busts (see, e.g., Green and Porter 1984, Rotemberg and Saloner 1986, Marques 1994 and Suslow 2005).

The industry and macroeconomic variables are defined in detail in the main text, so we do not repeat them here for brevity. However, it should be noted that for a small number of industries, we miss one or the other industry characteristic. For these, we use an imputed value, which is the predicted value of the 4-digit value, the prediction taken from a regression of the 4-digit value of the industry characteristic on the 2-digit value, measured in the same year. For those couple of observations where we also lack the 2-digit information, we use the 4-digit median. Our results are robust to excluding the observations with missing industry characteristics or, where possible, to including a separate dummy (*replace_d*) for these imputed observations. We can include it in all but those equations where the outcome variable has no variation conditional on *replace_d* taking value one (or zero). To keep the specification unchanged across the columns, the results reported below do not, however, include this dummy,

Tables A4-A6 report the marginal effects for the macro- and industry heterogeneity controls for Tables 6, 7 and 9 reported in the main text. Table A4 and A5 reports how the industry characteristics and macroeconomic variables are associated with the four economic dimensions and the clauses of which they consist, as well as with ICC, ICO and ECC. Table A6 reports how the industry characteristics and macroeconomic variables are associated with contract complexity and changes.

	Pricing	Market allocation	Efficiency	Technology	Non-price	Non-comp/spec.	ICC	ICO	ECC
Table A4. Marginal effects of MPA contract clause and other economic dimension probit regressions									
Log(members)	0.041	-0.059	-0.086**	-0.105***	-0.070**	-0.134**	0.261***	0.195***	0.159***
	(0.038)	(0.042)	(0.040)	(0.038)	(0.029)	(0.053)	(0.038)	(0.048)	(0.038)
Homogenous_d	0.015	0.219***	-0.066	-0.035	-0.052	-0.028	0.125	0.003	0.116**
	(0.061)	(0.067)	(0.062)	(0.072)	(0.071)	(0.095)	(0.098)	(0.059)	(0.057)
Hp_trend	-0.652**	-0.243	-	-0.065	-0.287	0.076	0.072	0.660	-0.133
	(0.332)	(0.367)		(0.218)	(0.331)	(0.299)	(0.324)	(0.415)	(0.315)
Gdp_neg	-0.598**	0.147	0.471*	0.974***	-1.703***	1.205***	0.133	-0.015	0.731*
	(0.259)	(0.524)	(0.279)	(0.257)	(0.385)	(0.368)	(0.432)	(0.310)	(0.434)
Gdp_pos	-0.587**	-0.265	-0.058	1.266***	-0.639***	0.129	0.168	-0.892**	1.436***
	(0.282)	(0.299)	(0.205)	(0.203)	(0.172)	(0.255)	(0.238)	(0.414)	(0.526)
Material share	-0.024	-0.395	0.334*	-0.328*	-0.320***	0.307	-0.145	-0.432*	-0.262
	(0.314)	(0.279)	(0.177)	(0.178)	(0.115)	(0.244)	(0.292)	(0.247)	(0.267)
Hours	-0.223	-0.754	-1.668	3.236**	-5.464***	3.768***	-2.792**	-0.051	1.626
	(2.182)	(2.163)	(1.862)	(1.579)	(2.079)	(1.309)	(1.331)	(1.617)	(1.200)
Gvp	0.001	0.025***	0.007	0.005	-0.011	-0.016**	0.026*	0.008	0.002
	(0.011)	(0.008)	(0.005)	(0.007)	(0.009)	(0.006)	(0.014)	(0.012)	(0.013)
Plants	-0.010	-0.054	-0.003	0.029	-0.020	-0.039	-0.029	-0.021	-0.003
	(0.030)	(0.041)	(0.013)	(0.023)	(0.029)	(0.041)	(0.043)	(0.034)	(0.032)
Reg. birth	0.143*	0.056	-0.001	0.026	0.054	0.006	-0.021	-0.140	0.052
	(0.083)	(0.098)	(0.004)	(0.060)	(0.084)	(0.075)	(0.085)	(0.105)	(0.088)
Observations	109	109	109	109	109	109	109	109	109

Notes: The table reports Probit marginal effects and standard errors (in parenthesis). Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively.

Table A5. Marginal effects of ICC, ICO and ECC contract clauses

	ICC				ICO					ECC		
	Moni-toring	Enforce-ment	Expel	Fine	Meeting	Dispute-resolution	Structure	Vote	Sales	New member	Non-cartel supply	Entry
Log(members)	-0.040	-0.056**	0.322***	-0.013	-0.002	0.030	0.252***	0.197***	0.121***	0.217***	-0.121***	-0.032
	(0.030)	(0.023)	(0.046)	(0.022)	(0.015)	(0.021)	(0.037)	(0.042)	(0.046)	(0.032)	(0.040)	(0.019)
Homogenous_d	0.189***	0.099**	-0.052	-0.029	-0.043	0.087	-0.136*	-0.073	-0.130	-0.109*	0.093	0.132*
	(0.046)	(0.041)	(0.075)	(0.057)	(0.059)	(0.086)	(0.080)	(0.065)	(0.101)	(0.065)	(0.076)	(0.073)
Hp_trend	0.102	-0.314	-0.215	0.093	-0.062	-0.568**	0.068	0.468*	-0.217	-0.257	-0.236	-0.369
	(0.336)	(0.196)	(0.222)	(0.263)	(0.139)	(0.250)	(0.292)	(0.270)	(0.345)	(0.383)	(0.196)	(0.299)
Gdp_neg	-0.424	-0.249	0.375	-0.228	0.208	0.679**	-0.361	-0.228	0.133	-0.173	0.568**	0.375
	(0.654)	(0.263)	(0.306)	(0.345)	(0.261)	(0.341)	(0.486)	(0.439)	(0.394)	(0.441)	(0.268)	(0.303)
Gdp_pos	-0.168	-0.379	0.404	0.020	-0.543**	-0.292	-0.786*	-0.897**	-0.609	-0.334	1.683***	0.459
	(0.384)	(0.356)	(0.252)	(0.340)	(0.253)	(0.495)	(0.459)	(0.416)	(0.411)	(0.403)	(0.370)	(0.469)
Material share	-0.260	-0.336***	0.146	-0.176	-0.237	-0.454	-0.366	-0.127	-0.335	-0.120	-0.191	0.016
	(0.320)	(0.122)	(0.231)	(0.249)	(0.162)	(0.358)	(0.233)	(0.321)	(0.358)	(0.207)	(0.170)	(0.166)
Hours	0.809	-0.023	1.482	-0.166	1.144	-2.660	-2.074	-3.500	-2.525	-0.275	2.324	1.339
	(1.445)	(1.360)	(1.718)	(1.967)	(1.590)	(2.608)	(2.984)	(3.785)	(2.478)	(2.203)	(1.940)	(1.653)
Gvp	0.042***	0.018***	-0.023**	0.015**	0.010*	0.013	-0.030**	-0.017	0.012	0.006	-0.006	-0.006
	(0.009)	(0.006)	(0.011)	(0.007)	(0.005)	(0.012)	(0.015)	(0.011)	(0.010)	(0.009)	(0.010)	(0.006)
Plants	-0.023	-0.002	-0.018	-0.017	-0.113*	-0.044	0.001	0.010	-0.065*	-0.044	-0.006	0.019
	(0.049)	(0.023)	(0.030)	(0.035)	(0.064)	(0.036)	(0.024)	(0.032)	(0.035)	(0.029)	(0.034)	(0.026)
Reg. birth	-0.045	0.070	0.074	-0.034	0.023	0.172**	-0.011	-0.128*	0.033	0.066	0.078	0.117
	(0.090)	(0.051)	(0.061)	(0.071)	(0.037)	(0.070)	(0.078)	(0.073)	(0.090)	(0.102)	(0.056)	(0.078)
Observations	109	109	109	109	109	109	109	109	109	109	109	109

Notes: The table reports Probit marginal effects and standard errors (in parenthesis). Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively.

Table A6. Contract complexity and stability

Variables	(1) #clauses	(2) #clauses	(3) #pages	(4) #pages	(5) #pages	(6) #changes	(7) #changes	(8) #changes
Hp_trend	-	-0.277	-	-	-1.416***	-	-	-5.075**
		(0.404)			(0.476)			(2.186)
Gdp_neg	-	0.491	-	-	0.458	-	-	1.545
		(0.593)			(0.461)			(2.780)
Gdp_pos	-	-0.151	-	-	0.620	-	-	4.592**
		(0.291)			(0.453)			(2.264)
Material share	-	-0.439	-	-	-0.190	-	-	-1.260
		(0.317)			(0.358)			(0.907)
Hours	-	-0.301	-	-	-2.181	-	-	-20.051**
		(2.734)			(2.907)			(8.188)
Gvp	-	0.009	-	-	-0.001	-	-	0.003
		(0.007)			(0.009)			(0.019)
Plants	-	-0.026	-	-	-0.027	-	-	0.058
		(0.032)			(0.047)			(0.095)
Reg. birth	-	0.076	-	-	0.353***	-	-	1.156**
		(0.109)			(0.124)			(0.527)
Replace_d	-	-0.104	-	-	0.351*	-	-	-0.223
		(0.125)			(0.202)			(0.500)
Constant	1.520***	-146.301	0.948***	0.626***	-686.137***	-0.735***	-0.795	-2,245.221**
	(0.072)	(212.786)	(0.107)	(0.123)	(240.777)	(0.261)	(0.563)	(1,023.449)
Observations	109	109	109	109	109	109	109	109

Notes: The table reports marginal effects and standard errors (in parenthesis). The standard errors are clustered by the registration year. Stars ***, **, and * indicate statistical significance at the 1, 5, and 10 % levels, respectively.

Appendix 4: Case studies

In this appendix we provide short case studies of three cartel contracts: one *Pricing*, one *Market allocation*, and one *Non-comp-Tech* cartel case. Our choice rule was to choose the earliest registered cartel in a homogenous goods industry that uses only one of the three aforementioned MPA clauses. The cartels that emerged are the match producers cartel (Case #1), the cement cartel (Case #2), and the plywood box cartel (Case #3).

Case #1: The match producers cartel

Finnish match producers formed a pricing cartel as early as 1927. The cartel consisted of an informal (unregistered) association and the Match Industry's Price Committee, as it was called. All Finnish match producers participated in this collaborative effort, but the number of members appears to have varied a little over time; at the time of registration, it had seven members. The cartel agreed on prices, discounts to wholesale customers and cash purchases. It also agreed on the size of match boxes, and on prices of different labels on the boxes, and therefore also *Non-price* takes values one. The cartel also decided that the contract would continue on a calendar year basis unless some of the parties discontinue it. The original contract contained no further clauses. When the cartel was contacted by the Registry in 1961, it stated as its objective the "organization of domestic sales of matches". It also announced some changes to the earlier agreement that had to do with the pricing of different labels. The organizational form changed in 1971 when the Finnish Match Association was formed – thus the value of *Structure,* which in our sample is derived from the contract at the time of registration, would have changed from zero to one in 1971. The Association took over the duties of the Price Committee. The cartel continued to fix prices, but now also had a written contract which is 3.5 pages long. The contract lists the members, states that there is to be an annual meeting, and has rules on voting and exit. Moreover, the contract has a clause on dispute resolution; in case of a dispute the members would resort to arbitration by the Finnish Chamber of Commerce. The final correspondence between the cartel and the Registry is in 1986: a member of the cartel has sent a letter stating that the Finnish Match Association has not had any activities "for a number of years". The Registry therefore decides to remove the cartel from the Registry as of 1986.

The match producers cartel is an example of a relatively small pricing cartel in a homogenous goods industry. They got by for more than 40 years with a relatively simple and informal organization, and by only using a few clauses. It is notable that they did not agree on any type of monitoring at any point, not even in 1971 when they changed for a much more formal organization and added several clauses to their contract.

Case#2: The cement cartel

The cement cartel is an example of a market allocation cartel in a homogenous goods market. The two Finnish cement producers' cartel was registered in 1959. The firms announced that they had agreed to divide Finland geographically, with the smaller firm (whose market share was given as 35%) concentrating on an area that in the south was round the capital Helsinki, and extended to the north. The production facility of the smaller member was located (in 1959) west of Helsinki in the town of Lohja. Both to west and east of this area, as well as north of it was the designated area of the larger member (with a market share of 65%). The reason for this split of the market was the location of production facilities. The larger competitor had in 1959 a production facility in the south-eastern town of Lappeenranta, which allowed it to service eastern Finland with the lowest possible transportation costs (as lake transport was readily available).

The other production facility of the larger member was in 1959 in the south-west town of Parainen on the coast. This location allowed relatively cheap sea transport to the northern port of Oulu and thereby northern Finland was allocated to this member (as the other was not located on the coast). The firms also produced quicklime with 1959 market shares of 20-50% for the larger firm and 20-40% for the smaller, depending on the type of quicklime.

There was further correspondence between the Registry and the cartel in 1966. The cartel declared that no essential changes in their operation had taken place, but notified the Registry that in parts of southern Finland both producers' cement is offered. The declared market shares were now "circa 64%" and "circa 35%". There is further correspondence in 1979, indicating that the market shares had remained much the same at "circa 64%" and "32-36%". The larger cartel member states in its letter that "the marketing areas of cement are determined by customer choices, driven largely by transport costs". This cartel has the simplest contract observed by us, as they only agreed on geography-based market allocation.[1]

Case #3: The plywood box cartel

Two manufacturers of plywood boxes made an agreement in 1964 whereby one of them ceased the production of these products altogether. It also committed itself to not re-enter the business for 15 years, and to neither sell nor allow the use of its machinery. Further, it committed to not reveal its know-how of plywood box production to any domestic competitor. We therefore coded this cartel to use two more clauses besides *Non-competition/specialization*: *Non-cartel supply* and *Entry*. As compensation the firm continuing production promised to pay a royalty on its plywood box revenues to the firm ceasing production. In the correspondence with the Registry the firms stated that this agreement did not result in a monopoly, and also asked for the Registry not to publish the clause on royalties. In 1981 the Registry approached the firms and they declared that the contract had not been extended, and that also the other firm had ceased production of plywood boxes. The cartel was therefore removed from the Registry.

In sum, we find that all these cartels used relatively short and simple contracts. This is consistent with the results that we report in the main text, as all three have a small number of members and are in homogenous goods industries.

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[1] It turns out that in separate contracts, given different entry numbers by the Registry, the two firms agreed on discounts with their downstream retailers. In effect, they ensured a price-cost margin to their retailers through these contracts without agreeing on a final price for their products.

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